Physics: Numerical Problems of Class 9th

Chapter 1: Physical Quantities and Measurements

H
E
L
P
I
N
G

H
A
N
D

B
L
O
O
M

N
O
T
E
S

1.1 Express the following quantities using prefix.
(a) 5000g = 5×10^{3} = **5kg ANS**
(b) 2000000W = 2×10^{6} = **2MW ANS**
(c) 52×10^{-10}kg = $5.2\times10^{1-10+3}$g = 5.2x10-6g = **5.2µg ANS**
(d) 225×10^{-8}s = $2.25\times10^{-8+2}$s = 2.25×10^{-6}g = **2.25µs ANS**

1.2 How do the prefixes micro, nano and pico relate to each other?
Given Data: micro = 10^{-6} nano = 10^{-9} pico = 10^{-12}
1pico = 10^{-9-3} = 10^{-6-6}
1pico = $10^{-3}10^{-9}$ = $10^{-6}10^{-6}$
pico = 10^{-3}nano = 10^{-6}micro ANS
nano = 10^{-3}micro ANS

1.3 Your hair grow at the rate of 1mm per day. Find their growth rate in nms^{-1}.
Given Data: Hair growth = 1mm per day
To find: Hair growth in nms^{-1}
Solution: As 1day = 86400s nano = 10^{-9}

As $\frac{\text{1mm}}{\text{day}} = \frac{1\times 10^{-3}m}{86400s}$

$= \frac{1\times10^{-3}\times10^{9}\times10^{-9}m}{86400s}$

$= \frac{1\times10^{-3+9}nm}{86400s}$ $\because 10^{-9}$ = nano = n

$= \frac{1\times10^{6}nm}{86400s}$

Hair growth in nms^{-1} $= 11.57nms^{-1}$ ANS

1.4 Rewrite the following in standard form.
Given Data:
(a) 1168×10^{-27} = $1.168\times10^{-27+3}$ = **1.168×10^{-24} ANS**
(b) 32×10^{5} = $3.2\times10^{5+1}$ = **3.2×10^{6} ANS**
(c) 725×10^{-5}kg = $7.25\times10^{2-5+3}$g = **7.25g ANS**
(d) 0.02×10^{-8} = $2\times10^{-8-2}$ = **2×10^{-10} ANS**

1.5 Write the following quantities in Standard form.
(a) 6400km = **6.4×10^{3}km ANS**
(b) 380000km = **3.8×10^{5}km ANS**
(c) 300000000ms-1 = **3×10^{8}ms^{-1} ANS**
(d) Seconds in a day = 86400s = **8.64×10^{4}s ANS**

1.6 On closing the jaws of a Vernier Callipers, zero of the vernier scale is on the right to its main scale such that 4th division of its vernier scale coincides with one of the main scale division. Find its zero error and zero correction.
Given Data: Vernier Scale is right to main scale's 4th division
To find: zero error & zero correction
Solution: As vernier scale is on right of main scale so zero error is positive. i.e. **zero error = +0.04cm ANS.**
Zero correction is negative of zero error i.e. **zero correction = -0.04cm ANS.**

1.7 A screw gauge has 50 divisions on its circular scale. The pitch of the screw gauge is 0.5mm. What is its least count?

Given Data: Screw gauge divisions = 50

Pitch of screw gauge = 0.5mm

To find: least count =?

Solution: least count = $\frac{pitch}{division}$

L.C = $\frac{0.5}{50} = \mathbf{0.01}\boldsymbol{mm} = \mathbf{0.001}\boldsymbol{cm}$ **ANS**

1.8 Which of the following quantities have three significant figures?

(a) 3.066m	**(No)**
(b) 5.05×10^{-27}kg	**(Yes)**
(c) 0.00309kg	**(Yes)**
(d) 301.0s	**(No)**

1.9 What are the significant figures in the following measurements?

(a) 1.009m	**(4)**
(b) 0.00450kg	**(3)**
(c) 1.66×10^{-27}kg	**(3)**
(d) 2.001s	**(4)**

1.10 A chocolate wrapper is 6.7cm long and 5.4cm wide. Calculate its area upto reasonable number of significant figures.

Given Data: Length= 6.7cm width=5.4cm

To find: area =?

Solution: area = l x w

= 6.7 x 5.4 = 36.18cm^2

But upto reasonable significant figures that is 2.

Area = 36cm^2 ANS

Numerical Problems of Class 9th

PHYSICS

Chapter 2: Kinematics

2.1 A train moves with a uniform velocity of 36kmh^{-1} for 10s. Find the distance travelled by it.

Given Data: v=36kmh^{-1} = 10 ms^{-1} t=10s

To find: S =?

Solution: S = vt = 10x10

S = 100m ANS

2.2 A train starts from rest. It moves through 1km in 100s with uniform acceleration. What will be its speed at the end of 100s.

Given Data: v_i = 0 ms^{-1} S = 1km = 1000m, t=100s

To find: v_f=?

Solution: 2nd Eq $S = v_i t + \frac{1}{2}at^2$

$1000 = 0\text{x}t + \frac{1}{2}a(100)^2$

$1000 = \frac{10000}{2}a \quad \Rightarrow a = 0.2\text{ms}^{-2}$

1st Eq $v_f = v_i + at = 0 + (0.2)(100)$

v_f = 20 ms^{-1} ANS

Alternate Method:

Given Data: vi = 0 ms^{-1} S = 1km = 1000m, t=100s

To find: vf=?

Solution: $S = v_{av}\text{x}t = (\frac{v_f+v_i}{2})t$

$\Rightarrow 1000 = (\frac{v_f+0}{2})100$

$\Rightarrow 1000 = \frac{v_f}{2}100$

$\Rightarrow 1000\text{x}2 = 100v_f$

$\Rightarrow v_f = \frac{2000}{100}$

$\Rightarrow v_f$ = 20ms^{-1} ANS

2.3 A car has a velocity of 10ms^{-1}. It accelerates at 0.2ms^{-2} for half minute. Find the distance travelled during this time and the velocity of the car.

Given Data: v_i = 10ms^{-1} a = 0.2 ms^{-2} t=$\frac{1}{2}$ min =30s

To find: S =? v_f =?

Solution: 2nd Eq $S = v_i t + \frac{1}{2}at^2$

$S = (10)(30) + \frac{1}{2}(0.2)(30)^2 \Rightarrow$ **S = 390m ANS**

1st Eq $v_f = v_i + at$ = 10 + (0.2)(30)

V_f = 16ms^{-1} ANS

2.4 A tennis ball is hit vertically upward with a velocity of 30ms^{-1}. It takes 3s to reach the highest point. Calculate the maximum height reached by the ball. How long it will take to return to ground?

Given Data: v_i = 30ms^{-1} t_{up} = 3s v_f = 0ms^{-1}

a = -g = 10ms^{-2}

To find: S =? t =?

Solution: 3rd Eq $2aS = v_f^2 - v_i^2$

$S = \frac{(v_f^2 - v_i^2)}{2a} = \frac{(0^2 - 30^2)}{2(-10)} = \frac{-900}{-20}$

S = 45m ANS

For Downward Movement

v_i = 30ms^{-1} a = g = 10 ms^{-2} S = 45m

t_{dn} = ?

2nd Eq $S = v_i t_{dn} + \frac{1}{2}at_{dn}^2$

45 = 0x$t_{dn} + \frac{1}{2}(10)t_{dn}^2$

45 = 5t_{dn}^2 $t_{dn}^2 = 9$

$t_{dn} = 3s$

t = t_{up} + t_{dn} = 3 + 3 = 6s

t = 6s ANS

2.5 A car moves with uniform velocity of 40ms^{-1} for 5s. It comes to rest in the next 10s with uniform deceleration. Find (i) deceleration (ii) total distance travelled by the car.

Given Data: v_i = 40ms^{-1} v_f = 0ms^{-1} t_1 = 5s t_2 = 10s

To find: a =? S =?

Solution: 1st Eq $v_f = v_i + at,\ a = \frac{v_f - v_i}{t}$

$a = \frac{0-40}{10}$ **a = -4ms^{-2} ANS**

S = S_1 + S_2

S_1 = v_it = 40 x 5 = 200m

2nd Eq $S_2 = v_i t + \frac{1}{2}at^2 = (40)(10) + \frac{1}{2}(-4)(10)^2$

S_2 = 400 - 200 = 200m

S = S_1 + S_2 = 200 + 200

S = 400m ANS

2.6 A train starts from rest with an acceleration of 0.5ms^{-2}. Find its speed in kmh^{-1}, when it has moved through 100m.

Given Data: v_i = 0ms^{-1} a = 0.5ms^{-2} S = 100m

To Find: v_f =? (in kmh^{-1})

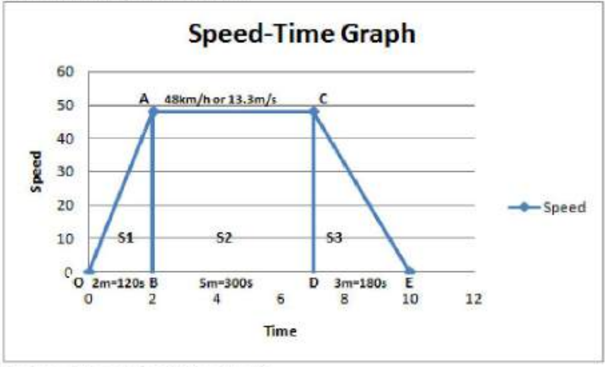
Solution: $2aS = v_f^2 - v_i^2 \Rightarrow v_f^2 = 2aS + v_i^2$

$v_f = \sqrt{2aS + v_i^2} = \sqrt{2(0.5)(100) + 0^2} = \sqrt{100}$

$v_f = 10ms^{-1} = \frac{10\times3600}{1000}$

$v_f = 36kmh^{-1}$ ANS

2.7 A train starting from rest accelerates uniformly and attains a velocity of 48kmh^{-1} in 2 minutes. It travels at this speed for 5 minutes. Finally, it moves with uniform retardation and is stopped after 3 minutes. Find the total distance travelled by the train.



Using Graphical Analysis

Given Data: $v_i = 0ms^{-1}$ $v_f = 48kmh^{-1} = 13.33ms^{-1}$

OE = 10min = 600s AC = 5min = 300s

To find: Total Distance = S =?

Solution: Total area under the graph is equal to the distance covered = area of trapezium OACE

S = $\frac{1}{2}$ (sum of parallel sides) x (perpendicular distance between parallel sides)

S = $\frac{1}{2}$ (OE + AC) x (AB)= $\frac{1}{2}$ (600+300) x (13.33) =5998.5m

S = 6000m ANS

Alternative Method

Given Data: For $S_1 \Rightarrow v_i = 0ms^{-1}$ v_f=48kmh^{-1} = 13.33ms^{-1} t_1 = 2m = 120s

For S_2 $\Rightarrow$ v = 48kmh^{-1} = 13.33ms^{-1} t_2 = 5m = 300s

For $S_3 \Rightarrow$ v_i=48kmh^{-1}=13.33ms^{-1} v_f = 0ms^{-1} t_1=3m = 180s

To Find: Total Distance S =?

Solution: For $S_1 \Rightarrow a = \frac{v_f - v_i}{t} = \frac{13.33-0}{120} = 0.111ms^{-1}$

$2aS = v_f{}^2 - v_i{}^2$

$S_1 = \frac{(v_f{}^2 - v_i{}^2)}{2a} = \frac{(13.33^2 - 0^2)}{2(0.111)} = 800m$

For $S_2 \Rightarrow S_2 = v_i t$ = 13.33 x 300 = 4000m

$S_3 \Rightarrow a = \frac{v_f - v_i}{t} = \frac{0-13.33}{180} = -0.074ms^{-1}$

$S_3 = \frac{(v_f{}^2 - v_i{}^2)}{2a} = \frac{(0^2 - 13.33^2)}{2(-0.074)} = 1200m$

$S = S_1 + S_2 + S_3$ = 800 + 4000 + 1200

S = 6000m ANS

2.8 A cricket ball is hit vertically upwards and returns to ground 6s later. Calculate (i) maximum height reached by the ball. (ii) initial velocity of the ball.

Given Data: t = 6s = $t_{up} + t_{dn}$ = 3s + 3s

$\Rightarrow t_{up}$ = 3s t_{dn} = 3s

$v_f = 0ms^{-1}$

a = -g = -10ms^{-2} (When ball going up)

To find: v_i =? $S_{max\ height}$ =?

Solution: 1st Eq $v_f = v_i + at$

$v_i = v_f - at = 0 - (-10)(3)$

$v_i = 30ms^{-1}$ ANS

2nd Eq $S_{\max\ height} = v_i t_{up} + \frac{1}{2} a t_{up}^2$

$S_{\max\ height} = (30)(3) + \frac{1}{2}(-10)(3)^2$

$S_{\max\ height} = 90 - 45$

$\boldsymbol{S_{\max\ height} = 45m}$ **ANS**

2.9 When brakes are applied, the speed of a train decreases from 96kmh^{-1} to 48kmh^{-1}in 800m. How much farther will the train move before coming to rest? (Assuming the retardation to be constant)

Given Data:

For $S_1 \Rightarrow$ vi = 96kmh^{-1} = 26.67ms^{-1}

v_f =48kmh^{-1} = 13.34ms^{-1} S_1 = 800m

For $S_2 \Rightarrow$ vi = 48kmh^{-1} = 13.34ms^{-1}

v_f =0ms^{-1}

To find: S_2 =? (Distance in Stage II)

Solution: $a = \frac{(v_f{}^2 - v_i{}^2)}{2S_1} = \frac{(13.34^2 - 26.67^2)}{2(800)} = -0.333ms^{-1}$

For $S_2 \Rightarrow S_2 = \frac{(v_f{}^2 - v_i{}^2)}{2a} = \frac{(0^2 - 13.34^2)}{2(-0.333)} = \frac{-17.76}{-0.666}$

$\boldsymbol{S_2 = 266.8m}$ **ANS**

2.10 In the above problem find the time taken by the train to stop after the application of the brakes.

Given Data: a = -0.333ms^{-2} vi = 96kmh^{-1}= 26.67ms^{-1}

v_f = 0ms^{-1}

To find: t =?

Solution: 1st Eq $v_f = v_i + at \Rightarrow t = \frac{v_f - v_i}{a}$

$t = \frac{0 - 26.67}{-0.333} \Rightarrow \boldsymbol{t = 80.0s}$ **ANS**

Numerical Problems of Class 9th

PHYSICS

Chapter 3: Dynamics

3.1 A force of 20N moves a body with an acceleration of $2ms^{-2}$. What is its mass?

Given Data: F = 20N $\quad$ $a = 2ms^{-1}$

To find: m =?

Solution: F = ma $\Rightarrow m = \frac{F}{a}$

$m = \frac{20}{2} \Rightarrow \boldsymbol{m = 10kg}$ **ANS**

3.2 The weight of a body is 147N. What is its mass? (Take value of g as $10ms^{-2}$)

Given Data: w = mg = 147N $\quad$ $g = 10ms^{-1}$

To find: m =?

Solution: w=mg $\Rightarrow m = \frac{w}{g}$

$m = \frac{147}{10} \Rightarrow \boldsymbol{m = 14.7kg}$ **ANS**

3.3 How much force is needed to prevent a body of mass 10kg from falling?

Given Data: m = 10kg $\quad$ $g = 10ms^{-1}$

To find: F =?

Solution: F = mg = 10 x 10

F = 100N ANS

3.4 Find acceleration produced by a force of 100N in a mass of 50kg.

Given Data: F = 100N $\quad$ m = 50kg

To find: a =?

Solution: F = ma $\Rightarrow a = \frac{F}{m}$

$a = \frac{100}{50} \Rightarrow \boldsymbol{a = 2ms^{-2}}$ **ANS**

3.5 A body has weight 20N. How much force is required to move it vertically upward with an acceleration of $2ms^{-2}$?

Given Data: w = 20N $\quad$ $a = 2ms^{-1}$

To find: F =?

Solution: $F = w + F_1$(Force to move vertically upward)

w = mg $\Rightarrow m = \frac{w}{g} = \frac{20}{10} = 2kg$

$F_1 = ma = 2 \times 2 = 4N$

$F = w + F_1 = 20 + 4 = 24N$
F = 24N ANS

3.6 Two masses 52kg and 48kg are attached to the ends of a string that passes over a frictionless pulley. Find the tension in the string and acceleration in the bodies when both the masses are moving vertically.

Given Data: $m_1 = 52$ kg $m_2 = 48$kg $g = 10ms^{-2}$
To find: T =? a =?
Solution: $T = \frac{2m_1m_{2g}}{m_1+m_2} = \frac{2(52)(48)(10)}{52+48}$
$\boldsymbol{T = 499.2 \approx 500N}$ **ANS**
$$a = \frac{(m_1 - m_2)g}{m_1 + m_2} = \frac{(52 - 48)10}{52 + 48}$$
$\boldsymbol{a = 0.4ms^{-2}}$ **ANS**

3.7 Two masses 36kg and 24kg are attached to the ends of a string which passes over a frictionless pulley. 26 kg is lying over a smooth horizontal surface. 24N is moving vertically downward. Find the tension in the string and the acceleration in the bodies.

Given Data: $m_1 = 24$ kg $m_2 = 26$kg $g = 10ms^{-2}$
To find: T =? a =? (When m_2 is moving on horizontal surface)
Solution: $T = \frac{m_1m_{2g}}{m_1+m_2} = \frac{(24)(26)(10)}{24+26}$
$\boldsymbol{T = 124.8 \approx 125N}$ **ANS**
$$a = \frac{m_1g}{m_1 + m_2} = \frac{(24)(10)}{24 + 26}$$
$\boldsymbol{a = 4.8ms^{-2}}$ **ANS**

3.8 How much time is required to change 22Ns momentum by a force of 20 N?

Given Data: F = 20N P = 22Ns
To find: t =?
Solution: $F=\frac{P}{t} \Rightarrow t = \frac{P}{F}$
$t = \frac{22}{20} \Rightarrow \boldsymbol{t = 1.1s}$ **ANS**

3.9 How much is the force of friction between a wooden block of mass 5kg and the horizontal marble floor? The coefficient of friction between wood and the marble is 0.6.

Given Data: m = 50kg $\mu_r = 0.6$ $g = 10ms^{-2}$
To find: $F_r = ?$
Solution: $F_r = \mu_r mg = (0.6)(5)(10)$
$\boldsymbol{F_r}$**= 30N ANS**

3.10 How much centripetal force is needed to make a body of mass 0.5kg to move in a circle of radius 50cm with a speed of $3ms^{-1}$?

Given Data: m = 0.5kg $v = 3ms^{-1}$ r = 50cm = 0.5m
To find: F_c=?
Solution: $F_c = \frac{mv^2}{r} = \frac{(0.5)3^2}{0.5}$
$\boldsymbol{F = 9N}$ **ANS**

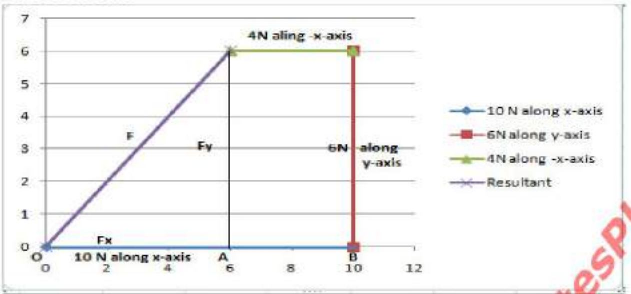
Numerical Problems of Class 9th

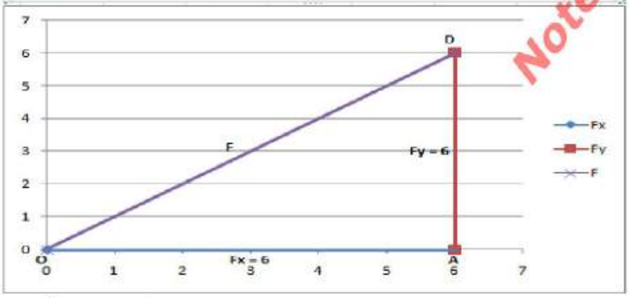
PHYSICS

Chapter 4: Turning Effect of Motion

4.1 Find the resultant of the following forces: (i) 10N along x-axis (ii) 6N along y-axis and (iii) 4N along negative x-axis.

Given Data:





F= $\sqrt{F_x^2 + F_y^2}$ = $\sqrt{6^2 + 6^2}$ ⇒ **F = 8.5N ANS**

θ = $\tan^{-1}(\frac{F_y}{F_x})$ = $\tan^{-1}(\frac{1}{1})$ ⇒ **θ = 45°ANS**

4.2 Find the perpendicular components of a force of 50N making an angle of 30° with x axis.

Given Data: F = 50N Angle with x-axis=$\theta = 30°$

To Find: F_x =? F_y =?

Solution: F_x = Fcos θ=50cos30° ⇒ **F_x = 43.3N ANS**

F_y = Fsin θ=50sin30° ⇒ **F_y = 25N ANS**

4.3 Find the magnitude and direction of a force, if its x-component is 12N and y-component is 5N.

Given Data: Fx = 12N Fy = 5N

To Find: F =? θ=?

Solution: $F = \sqrt{F_x^2 + F_y^2} = \sqrt{12^2 + 5^2}$ ⇒**F= 13N ANS**

$\theta = \tan^{-1} \frac{y}{F_x} = \tan^{-1} \frac{5}{12}$ ⇒**θ=45° With x-axis ANS**

4.4 A force of 100N is applied perpendicularly on a spanner at a distance of 10cm from a nut. Find the torque produced by the force.
Given Data: F = 100N d= 10cm = 0.1 m
To find: $\tau = ?$
$\tau = F \times d$ = 100 x 0.1 $\Rightarrow \boldsymbol{\tau} = \mathbf{10}\boldsymbol{Nm}$ **ANS**

4.5 A force is acting on a body making an angle of 30° with the horizontal. The horizontal component of the force is 20N. Find the force.
Given Data: Fx = 20N $\theta = 30°$ with x-axis
To find: F =?
Solution: F = $\frac{F_x}{\cos\theta} = \frac{20}{\cos 30}$ ⇒ **F = 23.1 N ANS**

4.6 The steering of a car has a radius 16cm. Find the torque produced by a couple of 50N.
Given Data: r = 16cm = 0.16m d =2r = 2(0.16) = 0.32m
F = 50N
To find: $\tau = ?$
$\tau = F \times d$ = 50 x 0.32 ⇒ $\boldsymbol{\tau} =$ **16Nm ANS**

4.7 A picture frame is hanging by two vertical strings. The tensions in the strings are 3.8N and 4.4N. Find the weight of the picture frame.
Given Data: T_1 = 4.4N T_2 = 3.8N
To Find: w =?
Solution: w = $T_1 + T_2$ = 4.4 + 3.8 ⇒ **w = 8.2N ANS**

4.8 Two blocks of masses 5kg and 3kg are suspended by two strings as shown. Find the tension in each string.
Given Data: m_1 = 5kg ⟹ $w_1 = m_1 g$ = 5x10 = 50N
m_2 = 3kg ⟹ $w_2 = m_2 g$ = 3x10 = 30N
To find: T_1 =? T_2 =?
Solution: T_1 = weight of both blocks = $w_1 + w_2$
T_1 = 50 + 30 ⟹ T_1 = 80N ANS
T_2 = weight of m_2 block = w_2 ⇒ **T_2 = 30N ANS**

4.9 A nut has been tightened by a force of 200N using 10cm long spanner. What length of spanner is required to loosen the same nut with 150N force?
Given Data: F_1 = 200N F2 = 150N d_1 = 10cm =0.1m
To find: d_2 =?
Solution: As torque is equal in both cases so
$F_1 \times d_1 = F_2 \times d_2 \Rightarrow d_2 = \frac{F_1 \times d_1}{F_2} = \frac{200 \times 0.1}{150} = 0.1333m$
d_2 = 13.3cm ANS

4.10 A block of mass 10kg is suspended at a distance of 20cm from the center of a uniform bar 1m long. What force is required to balance it at its center of gravity by applying the force at the other end of the bar?
Given Data: m = 10kg F_1 = w = mg = 10x10 = 100N
d_1 = 0.2m d_2 = 0.5m
To find: F_2 =?
Solution: As both torques will be equal to balance. $F_1 \times d_1 = F_2 \times d_2 \Rightarrow F_2 = \frac{F_1 \times d_1}{d_2} = \frac{100 \times 0.2}{0.5}$ ⇒ **F_2 = 40N**

Numerical Problems of Class 9th

PHYSICS

Chapter 5: Gravitation

5.1 Find the gravitational force of attraction between two identical spheres of mass 1000kg. The distance between the centers of the spheres is 0.5m.

Given Data: $G = 6.673 \times 10^{-11} Nm^2kg^{-2}$

$d = 0.5m$ $m = m_1 = m_2 = 1000kg$

To find: $F_g = ?$

Solution: $F = G\frac{m_1 m_2}{d^2} = G\frac{m^2}{d^2}$

$F = \frac{(6.673\text{x}10^{-11})(1000)^2}{0.5^{`2}}$ $\Rightarrow$**$F = 2.67\text{x}10^{-4}N$ ANS**

5.2 The gravitational force between two identical lead spheres kept at 1m apart is 0.006673N. Find their masses.

Given Data: $F = 0.006673N$ $d = 1m$ $G = 6.673\text{x}10^{-11}Nm^2kg^{-2}$

To find: $m = m_1 = m_2 = ?$

Solution: $F = G\frac{m_1 m_2}{d^2} = G\frac{m^2}{d^2}$

$m = \sqrt{\frac{Fd^2}{G}} = \sqrt{\frac{(0.006673)1^2}{6.673\text{x}10^{-11}}} = \sqrt{100000000}$

$m = m_1 = m_2 = 10000kg$ ANS

5.3 Find the acceleration due to gravity on the surface of the Mars. The mass of Mars is $6.42\text{x}10^{23}$kg and its radius is 3370km.

Given Data: $M_m = 6.42\text{x}10^{23}kg$ $R_m = 3370km = 3.37\text{x}10^6m$

To find: **$g_{mars} = ?$**

Solution: $g_m = \frac{GM_m}{R_m^2} = \frac{6.673\text{x}10^{-11} \times 6.42\text{x}10^{23}}{(3.37\text{x}10^6)^2}$

$g_m = 3.77ms^{-2}$ ANS

5.4 The acceleration due to gravity on the surface of moon is $1.62ms^{-2}$. The radius of moon is 1740km. Find the mass of moon.

Given Data: $g = 1.62ms^{-2}$ $G = 6.673\text{x}10^{-11}Nm^2kg^{-2}$

$R_m = 1740km = 1.74\text{x}10^6$

To find: $M_m = ?$

Solution: $g_m = \frac{GM_m}{R_m^2} \Rightarrow M_m = \frac{g_{mR_m^2}}{G} = \frac{(1.62)(1.74\times10^6)^2}{6.673\text{x}10^{-11}}$

$\boldsymbol{M_m = 7.35 \times 10^{22} kg}$ **ANS**

5.5 Calculate the value of g at a height of 3500km above the surface of the Earth.

Given Data: $R_e = 6.4\text{x}10^6\text{m}$ $h = 3.6\text{x}10^6\text{m}$

$M_e = 6\text{x}10^{24}\text{kg}$ $G = 6.673\text{x}10^{-11}\text{Nm}^2\text{kg}^{-2}$

To find: g_h =?

Solution: $g_h = \frac{GM_e}{(R+h)^2} = \frac{6.673\text{x}10^{-11}\times 6\text{x}10^{24}}{(6.4\text{x}10^6+3.6\times 10^6)^2}$

$\boldsymbol{g_h = 4.00\ ms^{-2}}$ **ANS**

5.6 Find the value of g due to the Earth at geostationary satellite. The radius of the geostationary orbit is 48700km.

Given Data: $M_e = 6\text{x}10^{24}\text{kg}$ $G = 6.673\text{x}10^{-11}\text{Nm}^2\text{kg}^{-2}$

$R+h = 48700\text{km} = 4.87\text{x}10^7\text{m}$

To find: g_h =?

Solution: $g_h = \frac{GM_e}{(R+h)^2} = \frac{6.673\text{x}10^{-11}\times 6\text{x}10^{24}}{(4.87\text{x}10^7)^2}$

$\boldsymbol{g_h = 0.168\ ms^{-2}} \approx$ **0.17ms^{-2} ANS**

5.7 The value of g is 4.0ms^{-2} at a distance of 10000km from the center of the Earth. Find the mass of the Earth.

Given Data: $g_h = 4.0\text{ms}^{-2}$R+h = 10000km = $1\text{x}10^7$m

To find: M_e =?

Solution: $g_h = \frac{GM_e}{(R+h)^2} \Rightarrow M_e = \frac{g_h(R+h)^2}{G}$

$M_e = \frac{4(1\times 10^7)^2}{6.673\text{x}10^{-11}} \Rightarrow \boldsymbol{M_e = 5.99 \times 10^{24} kg}$ **ANS**

5.8 At what altitude the value of g would become one fourth than on the surface of the Earth.

Given Data: $g_h = \frac{g}{4}$ ----(i)

To find: h =?

Solution: As we know that g=$\left[\frac{GM_e}{R^2}\right]$ and g_h =$\left[\frac{GM_e}{(R+h)^2}\right]$ putting the value of g and g_h in eq (i).

$g_h = \frac{g}{4} \Rightarrow \frac{GM_e}{(R+h)^2} = \frac{1}{4}\frac{GM_e}{R^2} \Rightarrow \frac{1}{(R+h)^2} = \frac{1}{4R^2}$

By Cross multiplication: $(R+h)^2 = 4R^2$

Taking Square root on Both Sides: $R + h = 2R$

$h = 2R - R \Rightarrow \boldsymbol{h = R}$ **So the altitude will be equal to the Radius of Earth. ANS**

5.9 A polar satellite is launched at 850km above Earth. Find its orbital speed.

Given Data: R = $6.4\text{X}10^6$m h=850km=$8.5\text{x}10^5$km

G= $6.673\text{x}10^{-11}\text{Nm}^2\text{kg}^{-2}$

To find: v_o =?

Solution: $g_h = \frac{GM_e}{(R+h)^2} = \frac{6.673\text{x}10^{-11}\times 6\text{x}10^{24}}{(6.4\text{x}10^6+8.5\text{x}10^5)^2}$ =7.612ms^{-2}

$v_o = \sqrt{g_h(R+h)}$=$\sqrt{7.617(6.4\text{x}10^6 + 8.5\text{x}10^5)}$

$\boldsymbol{v_o}$ = **7431ms^{-1} ANS**

5.10 A communication satellite is launched at 42000km above Earth. Find its orbital speed.

Given Data:

R = $6.4\text{X}10^6$m h=42000km=$4.2\text{x}10^7$km

G= $6.673\text{x}10^{-11}\text{Nm}^2\text{kg}^{-2}$

To find: v_o =?

Solution: $g_h = \frac{GM_e}{(R+h)^2} = \frac{6.673\text{x}10^{-11} * 6\text{x}10^{24}}{(6.4\text{x}10^6+4.2\text{x}10^7)^2}$=0.1709ms^{-2}

$v_o = \sqrt{g_h(R+h)}$=$\sqrt{0.1709(6.4\text{x}10^6 + 4.2\text{x}10^7)}$

$\boldsymbol{v_o}$ = **2876ms^{-1} ANS**

Numerical Problems of Class 9^{th}

PHYSICS

Chapter 6: Work and Energy

6.1 A man has pulled a cart through 35m applying a force of 300N. Find the work done by the man.
Given Data: Force = F = 300N Distance = d= 35m
To find: Work = W = ?
Solution: W = F.S = 300 x 35 ⇒ **W = 10500J ANS**

6.2 A block weighing 20N is lifted 6m vertically upward. Calculate the potential energy stored in it.
Given Data: Weight = w = mg = 20N h = 6m
To find: Potential Energy = ?
Solution: P.E = mgh = 20 X 6 ⇒ **P.E 120J ANS**

6.3 A car weighing 12kN has a speed of $20ms^{-1}$. Find its kinetic energy.
Given Data: W = mg = 12kN = 12000N
m = $\frac{w}{g} = \frac{12000}{10}$ = 1200kg v = $20ms^{-1}$
To find: K.E =?
Solution: K.E =$\frac{1}{2}mv^2 = \frac{1}{2}(1200)(20)^2$
K.E = 240000J = 240kJ ANS

6.4 A 500g stone is thrown up with a velocity of $15ms^{-1}$. Find its (i) P.E. at its maximum height.(ii) K.E. when it hits the ground.
Given Data: m = 500g = 0.5kg v = $15ms^{-1}$
To find: K.E =? P.E =?
Solution: K.E =$\frac{1}{2}mv^2 = \frac{1}{2}(0.5)(15)^2$
K.E = 56.25J ANS
For upward movement: $v_i = 15ms^{-1}$ $v_f = 0ms^{-1}$
$g = -10ms^{-2}$ h =?

$$2gh = v_f{}^2 - v_i{}^2 \Rightarrow h = \frac{(v_f{}^2 - v_i{}^2)}{2g}$$

$h = \frac{(0^2-15^2)}{2(-10)} = \frac{-225}{-20}$ ⇒ h = 11.25m
P.E = mgh = 0.5 X 10 X 11.25 ⇒ **P.E = 56.25J ANS**
Total amount of energy remains constant.

6.5 On reaching the top of a slope 6m high from its bottom a cyclist has a speed of 1.5ms^{-1}. Find the kinetic energy and the potential energy of the cyclist. The mass of the cyclist and his bicycle is 40kg.

Given Data: v = 1.5 ms^{-1} m = 40kg h = 6m

To find: K.E =? P.E =?

Solution: K.E $= \frac{1}{2}mv^2 = \frac{1}{2}(40)(1.5)^2 \Rightarrow$ **K.E = 45J ANS**

P.E = mgh = 40 x 10 x 6 ⇒ **P.E = 2400J ANS**

6.6 A motor boat moves at a steady speed of 4ms^{-1}. Water resistance acting on it is 4000N. Calculate the power of its engine.

Given Data: F = 4000N v = 4ms^{-1}

To find: P =?

Solution: $P = \frac{W}{t} = \frac{FS}{t}$ (W=FS) (v=S/t)

P = Fv = 4000 x 4 ⇒ **P = 16000W = 16kW ANS**

6.7 A man pulls a block with a force of 300N through 50m in 60s. Find the power used by him to pull the block.

Given Data: F = 300N S = 50m t = 60s

To find: Power = P =?

$P = \frac{W}{t} = \frac{FS}{t} = \frac{300\times50}{60}$ ⇒ **P = 250W ANS**

6.8 A 50kg man moved 25 steps up in 20 seconds. Find the power, if each step is 16cm high.

Given Data: m = 50kg Steps =25 t =20s

Height of one step = 16cm = 0.16m

Height of 25 steps = 0.16x25 = 4m

To find: P =?

Solution: $P = \frac{W}{t} = \frac{FS}{t} = \frac{mgh}{t} = \frac{50\times10\times4}{20}$

P = 100Watts ANS

6.9 Calculate the power of a pump which can lift 200kg of water through a height of 6m is 10 seconds.

Given Data: m= 200kg t = 10s h = 6m

To find: P =?

Solution: $P = \frac{W}{t} = \frac{FS}{t} = \frac{mgh}{t} = \frac{200\times10\times6}{10}$

P = 1200Watts ANS

6.10 An electric motor of 1hp is used to run water pump. The water pump takes 10 minutes of fill an overhead tank. The tank has a capacity of 800 liters and height of 15m. Find the actual work done by the electric motor to fill the tank. Also find the efficiency of the system. (Density of water = 1000kgm^{-3}) (Mass of 1 liter of water = 1kg)

Given Data: Input Power of motor = 1hp = 746W

Time taken=t=10m=600s Height = h = 15m

Density of water = ρ = 1000kgm^{-3}

Mass of 1 liter of water = 1kg

To find: Input work = W_i =? %Efficiency =?

Solution: $P_i = \frac{W_i}{t} \Rightarrow W_i = P_i \times t = 746 \times 600$

$\boldsymbol{W_i = 447600J}$ **ANS**

Mass of 800l water = m = 800kg

Output Work= P.E = mgh=800x10x15 ⇒ P.E = 120000J

%Efficiency = $\frac{Output}{Input} \times 100\% = \frac{120000}{447600} \times 100\%$

%Efficiency =26.8% ANS

Numerical Problems of Class 9^{th}

PHYSICS

Chapter 7: Properties of Matter

7.1 A wooden block measuring 40cmx10cmx5cm has a mass of 850g. Find the density of wood.

Given Data: Mass = m = 850g = 0.85kg

Volume = $V = \frac{40}{100} \times \frac{10}{100} \times \frac{5}{100} = 2 \times 10^{-3} m^3$

To find: Density = ρ =?

Solution: $\rho = \frac{mass}{Voulume} = \frac{0.85}{2 \times 10^{-3}}$

$\rho = 425kgm^{-3}$ ANS

7.2 What would be the volume of ice formed by freezing 1 liter of water?

Given Data: Volume (water) = V_w = 1 liter = $1x10^{-3}m^3$

Density (water) = $\rho_w = 1000kgm^{-3}$

Density (ice) = $\rho_i = 920kgm^{-3}$

To find: Volume (ice) = V_i =?

Solution: We know that

$m_w = \rho_w V_w$

Also

$m_i = \rho_i V_i$

$m_w = m_i$

$\rho_w V_w = \rho_i V_i \Rightarrow \rho_i = \frac{\rho_w \times V_w}{V_i} = \frac{1000 \times 10^{-3}}{920}$

$\rho_i = 1.09x10^{-3}m^3$ ρ_i = 1.09l ANS

7.3 Calculate the volume of the following objects:

(i) An iron sphere of mass 5kg, the density of iron is $8200kgm^{-3}$.

(ii) 200g of lead shot having density $113000kgm^{-3}$.

(iii) A gold bar of mass 0.2kg. The density of gold is 19300 kgm^{-3}.

Given Data:

(a) m = 5kg $\rho = 8400kgm^{-3}$

To find: V =?

Solution: $V = \frac{m}{\rho} = \frac{5}{8200} \Rightarrow \boldsymbol{V = 6.1 \times 10^{-4} m^3}$ **ANS**

(b) m = 200g = 0.2kg $\rho = 11300kgm^{-3}$

To find: V =?

Solution: $V = \frac{m}{\rho} = \frac{0.2}{11300} \Rightarrow \boldsymbol{V = 1.77 \times 10^{-5} m^3}$ **ANS**

(c) $m = 200g = 0.2kg$ $\rho = 19300kgm^{-3}$
To find: $V = ?$
Solution: $V = \frac{m}{\rho} = \frac{0.2}{19300} \Rightarrow \boldsymbol{V = 1.04 \times 10^{-5} m^3}$ **ANS**

7.4 The density of air is 1.3kgm^{-3}. Find the mass of air in a room measuring 8mx5mx4m.
Given Data: $\rho = 1.3kgm^{-3}$ $V = 8x5x4 = 160m^3$
To find: $m = ?$
Solution: $m = \rho V = 1.3 \times 160$
m = 208kg ANS

7.5 A student presses her palm by her thumb with a force of 75N. What would be the pressure under her thumb having contact area 1.5cm^2?
Given Data: $F = 75N$ $A = 1.5cm^2 = 1.5x10^{-4}m^2$
To find: $P = ?$
Solution: $P = \frac{F}{A} = \frac{75}{1.5\times10^{-4}}$ $\Rightarrow$ **$P = 5x10^5Nm^{-2}$ ANS**

7.6 The head of pin is square of side 10mm. Find the pressure on it due to a force of 20N.
Given Data: $F = 20N$ $L = \frac{10}{1000} = 1 \times 10^{-2}m$
$A = L^2 = (1x10^{-2})^2 = 1x10^{-4}m^2$
To find: $P = ?$
Solution: $P = \frac{F}{A} = \frac{20}{1\times10^{-4}}$ $\Rightarrow$**$P = 2x10^5Nm^{-2}$ ANS**

7.7 A uniform rectangular block of wood 20cmx7.5cmx7.5cm and of mass 1000g stands on a horizontal surface with its longest edge vertical. Find (i) the pressure exerted by the block on the surface (ii) density of the wood.
Given Data: Volume=$V = \frac{20}{100} \times \frac{7.5}{100} \times \frac{7.5}{100} = 1.125x10^{-3}m^3$
Mass = $m = 1kg$
To find: (i) $P = ?$ (ii) ρ of wood
Solution: $F = w = mg = 1x10 = 10N$
$A = 0.075 X 0.075 = 5.625x10^{-3}m^2$
$P = \frac{F}{A} = \frac{10}{5.625\times10^{-3}}$ $\Rightarrow$ **(i) $P = 1778Nm^{-2}$ ANS**
Density=$\frac{m}{V} = \frac{1}{1.125\times10^{-3}}$ $\Rightarrow$**(ii)density=ρ=889kgm^{-3}ANS**

7.8 A cube of glass of 5 cm side and mass of 306 g, has a cavity inside it. If the density of glass is 2.55gcm^{-3}. Find the volume of the cavity.
Given Data: Side of cube = $x = 5cm = 0.05m$
Mass of cube = $m = 306g = 0.306kg$
To find: $V_{cavity} = ?$
Solution: $V_1 = x^3 = (0.05)^3 = 1.25x10^{-4}m^3$
Density = $2.55gcm^{-3} = 2550kgm^{-3}$
Volume = $\frac{m}{\rho} = \frac{0.306}{2550} \Rightarrow V = 1.2x10^{-4}m^3$
$V_{Cavity} = V - V_1 = 1.25x10^{-4} - 1.2x10^{-4} = 0.05x10^{-4}m^3$
$V_{Cavity} = 5x10^6m^3 = 5cm^3$ ANS

7.9 An object has weight 18N in air. Its weight is found to be 11.4N when immersed in water. Calculate its density. Can you guess the material of the object?
Given Data: Weight of the object in air = 18N
Weight of the object immersed in water = 11N
$\rho = 1000kgm^{-3}$

To find: D =?   Material Name =?

Solution: D = $\frac{w_1}{w_1-w_2} \times \rho = \frac{18}{18-11} \times 1000$

D = 2727kgm^{-3} Material in Aluminum ANS

7.10 A solid block of wood of density 0.6gcm^{-3} weighs 3.06N in air. Determine (a) volume of the block (b) the volume of the block immersed when placed freely in a liquid of density 0.9gcm^{-3}?

Given Data:

Density of solid block = D = 0.6gcm^{-3} = 600kgm^{-3}

Weight of block in air = 3.06N

To find: (a) Volume of block   (b) Volume of block immersed in liquid of density = 900kgm^{-3}

Solution: (a) w = mg ⇒ $m = \frac{w}{g} = \frac{3.06}{10} = 0.306kg$

V= $\frac{m}{D} = \frac{0.306}{600} = 5.1 \times 10^{-4}m^3 \Rightarrow \boldsymbol{V = 510cm^3}$ **ANS**

(b) As solid replaces equal liquid so weight is equal then the mass = 0.306kg density = 900kgm^{-3}

V= $\frac{m}{D} = \frac{0.306}{900} = 3.4 \times 10^{-4}m^3 \Rightarrow \boldsymbol{V = 340cm^3}$**ANS**

7.11 The diameter of the piston of hydraulic press is 30cm. How much force is required to lift a car weighing 20000N on its piston if the diameter of the piston of the pump is 3cm?

Given Data:

Diameter of piston of hydraulic press =d_1=30cm= 0.3m

Radius of piston of hydraulic press = r_1 = 0.15m

Cross-sectional areas of piston of hydraulic press = A = $\pi r_1^2 = \pi(0.15)^2 = 0.0225\pi$

Force on piston of hydraulic press = weight of car = F_2 = 20000N

Diameter of piston of pump= d_1 = 3cm = 0.03m

Radius of piston of pump = r_2 = 0.015m

Cross-sectional areas of piston of pump = a= $\pi r_2^2 = \pi(0.015)^2 = 0.000225\pi$

To find: Force on small piston = Force required to lift a car = F_1 =?

Solution: According to Pascal Law the pressure on both pistons will be same ⇒ $P_1 = P_2$

$\frac{F_1}{a} = \frac{F_2}{A}$

⇒ $F_1 = \frac{F_2 \times a}{A} = \frac{20000 \times 0.000225\pi}{0.0225\pi} = 20000 \times 0.01$

F_2 = 200N ANS

7.12 A steel wire of cross-sectional area 2x10^{-5}m^2 is stretched through 2mm by a force of 4000N. Find the Young's modulus of het wire. The length of the wire is 2m.

Given Data:

Cross sectional area of wire = A = 2x10^{-5}m^2

Change in its length = ΔL = 2mm = 0.002m

Force applied = F = 4000N

Actual length of wire = L_o = 2m

To find: Young's Modulus = Y =?

Solution: Y= $\frac{FL_\circ}{\Delta LA} = \frac{4000 \times 2}{0.002 \times 2 \times 10^{-5}}$

Y = 2x10^{11}Nm^{-2} ANS

Numerical Problems of Class 9th

PHYSICS

Chapter 8: Thermal Properties of Matter

8.1 Temperature of the water in a beaker is 50°C. What is its value in Farenheit scale?

Given Data: Temperature in Celsius = Tc = 50°C

To find: Temp in Farenheit = T_F =?

Solution: $T_F = \frac{9}{5}T_C + 32 = \frac{9}{5}(50) + 32$

T_F = 122°F ANS

8.2 Normal human body temperature is 98.6F. Convert it into Celsius scale and Kelvin scale.

Given Data:

Norma l temperature of human body = TF = 98.6oF

To find: Temperature in Celsius = TC =?

Temperature in Kelvin TK =?

Solution: $T_C = \frac{5}{9}(T_F - 32) = \frac{9}{5}(98.6 - 32)$= 37°C = T_C

$T_K = T_C + 273 = 37 + 273 \Rightarrow$ **T_K = 310 ANS**

8.3 Calculate the increase in the length of an aluminum bar 2m long when heated from 0°C to 20°C. The thermal coefficient of linear expansion of aluminum is $2.5\text{x}10^{-5}K^{-1}$.

Given Data: Length of Aluminum = Lo = 2m

Change in temperature = 20°C = 20K

Co-efficient of linear expansion = α = $2.5\text{x}10^{-5}K^{-1}$

To find: Increase in length = ΔL =?

Solution: $\Delta L = \alpha L o \Delta T = 2.5\text{X}10^{-5}\text{x}2\text{x}20$

$\Delta L = 1\text{x}10^{-3}$m = 0.1cm ANS

8.4 A balloon contains 1.2m^3 air at 15°C. Find its volume at 40°C. Thermal coefficient of volume expansion of air is $3.67\text{x}10^{-3}K^{-1}$.

Given Data: Initial Volume = Vo = 1.2 m^3

Initial temperature = To = 15^{O}C = 288K

Final temperature = T = 40^{O}C = 313K

Co-efficient of Volumetric expansion = β = $3.67\text{x}10^{-3}K^{-1}$

To find: Final Volume =?

Solution:

$V = Vo[1+\beta(T-To)] = 1.2[1+3.67\text{x}10^{-3}(313-288)]$

V = 1.3m^3 ANS

8.5 How much heat is required to increase the temperature of 0.5kg of water from 10°C to 65°C?

Given Data: Initial temperature = To = 10^{O}C = 283K

Final temperature = T = $65^{O}C$ = 338K

Change in temperature = ΔT = T-To =55K

Specific heat of water = c = $4200Jkg^{-1}K^{-1}$

Mass of water = 0.5kg

To find: Heat = Q =?

Solution: Q = $cm\Delta T$ = 4200x0.5x55

Q = 11500J ANS

8.6 An electric heater supplies heat at the rate of 1000 joules per second. How much time is required to raise the temperature of 200g of water from 20°C to 90°C?

Given Data: Initial temperature = To = $20^{O}C$ = 293K

Final temperature = T = $90^{O}C$ = 363K

Change in temperature = ΔT = T-To =70K

Rate at which heat supplied = $\frac{Q}{t} = 1000Js^{-1}$

Mass of water = 200g= 0.2kg

To find: time taken =?

Solution: Q = $cm\Delta T$ Dividing both sides by't'.

$\Rightarrow \frac{Q}{t} = \frac{cm\Delta T}{t} \Rightarrow 1000 = \frac{4200 \times 0.2 \times 70}{t} \Rightarrow 1000 = \frac{58800}{t}$

t = $\frac{58800}{1000}$ $\Rightarrow$ **t= 58.8s ANS**

8.7 How much ice will melt by 50000J of heat? Latent heat of fusion of ice = $336000Jkg^{-1}$.

Given Data: Q_f = 50000J

Latent heat of fusion of ice = H_f = 336000 Jkg^{-1}

To find: mass of ice = m =?

Solution: $Q_f = mH_f \Rightarrow m = \frac{Q_f}{H_f} = \frac{50000}{336000}$

m = 0.1488 $\approx$ 0.150kg = 150g ANS

8.8 Find the quantity of heat needed to melt 100g of ice at -10°C into water at 10°C.

(Note: Specific heat of ice is $2100Jkg^{-1} K^{-1}$, specific heat of water is $4200Jkg^{-1}K^{-1}$, Latent heat of fusion of ice is $336000Jkg^{-1}$)

Given Data: Mass of ice = m_1 = 100g = 0.1kg

Specific heat of ice = c_1 = $2100Jkg^{-1}K^{-1}$

Initial temperature of ice = T_1 = -10°C = 263K

Mass of water = m_2 = 100g = 0.1kg

Specific heat of water = c_2 = $4200Jkg^{-1}K^{-1}$

Latent heat of fusion of ice = H_f = $336000Jkg^{-1}$

Final temperature = T_2 = 10°C = 283K

To find: Quantity of heat = Q =?

Solution: Firstly find the heat required by ice to increase its temperature from 263K to 273K = Q_1

$Q_1 = c_1m_1\Delta T$

Q_1 = 2100 x 0.1 x (273 - 263)

Q_1 = 210 x 10

Q_1 = 2100J

Secondly find the heat required to melt ice at 273K without increase in temperature = Q_2

$Q_2 = m_1H_f$ = 0.1 x 336000

Q_2= 33600J

Thirdly find the heat required to increase the temperature of water from 273K to 283K = Q_3

$Q_3 = c_2m_2\Delta T$

Q_3 = 4200 x 0.1 (283 - 273)

$Q_3 = 420 \times 10$

$Q_3 = 4200J$

Total heat required to increase the temperature of ice at 263K to 283K (water) = Q

$Q = Q_1 + Q_2 + Q_3 = 2100 + 33600 + 4200$

$Q = 39900J$ ANS

8.9 How much heat is required to change 100g of water at 100°C into steam? (Latent of heat of vaporization water is $2.26 \times 10^6 Jkg^{-1}$)

Given Data: $m = 100g = 0.1kg \quad Hv = 2.26 \times 10^6 Jkg^{-1}$

To find: $Qv = ?$

Solution: $Qv = mHv = 0.1 \times 2.26 \times 10^6$

$Qv = 2.26 \times 10^5 J$ ANS

8.10 Find the temperature of water after passing of 5g of steam at 100°C through 500g of water at 10°C. (Note: Specific heat of water is $4200Jkg^{-1}K^{-1}$, Latent of heat of vaporization water is $2.26 \times 10^6 Jkg^{-1}$)

Given Data: Mass of steam = $m_1 = 5g = 5 \times 10^{-3} kg$

Temperature of steam = $T_1 = 100°C = 383K$

Mass of water = $m_2 = 500g = 0.5kg$

Initial temperature of water = $T_2 = 10°C = 283K$

Specific heat of water = $c = 4200Jkg^{-1}K^{-1}$

Heat of vaporization = $Hv = 2.26 \times 10^6 Jkg^{-1}$

To find: Final Temperature of water = T=?

Solution: After passing steam through water

heat released by steam = Heat absorbed by water

$m_1Hv + m_1c\Delta T = m_2c\Delta T$

$m_1Hv + m_1c(T_1 - T) = m_2c(T - T_2)$

$(5 \times 10^{-3})(2.26 \times 10^6) + (5 \times 10^{-3})(4200)(373 - T) = (0.5)(4200)(T - 283)$

$11300 + 21(373 - T) = 2100(T - 283)$

$11300 + 7833 - 21T = 2100T - 594300$

$2100T + 21T = 11300 + 7833 + 594300$

$2121T = 613433$

$T = \frac{613433}{2121} = 289.2K$

$T_C = T_K - 273 = 289.2 - 273$

$T_C = 16.2°C$ ANS

Numerical Problems of Class 9th

PHYSICS

Chapter 9 Transfer of Heat

9.1 The concrete roof of a house of thickness 20cm has an area 200m^2. The temperature inside the house is 15°C and outside is 35°C. Find the rate at which thermal energy will be conducted through the roof. The value of k for concrete is 0.65Wm^{-1}K^{-1}.

Given Data: L = 20cm = 0.2m A = 200m^2

$T2 = 35°C = 308K$ $T1 = 15°C = 288K$

$\Delta T = T2 - T1 = 308 - 288 = 20K$

Thermal conductivity = 0.65Nm^{-1}K^{-1}

To Find: Rate of flow of heat = $\frac{Q}{t}$ =?

Solution: $\frac{Q}{t} = \frac{KA(\Delta T)}{L} = \frac{0.65\times200\times20}{0.2}$

$\frac{Q}{t}$ = 13000Js^{-1} ANS

9.2 How much heat is lost in an hour through a glass window measuring 2.0m by 2.5m when inside temperature is 25°C and that of outside is 5°C, the thickness of glass is 0.8cm and the value of k for glass is 0.8Wm^{-1}K^{-1}?

Given Data:

t = 1 hour = 3600s

L = 0.8cm = 0.008m A = 2x2.5 = 5m^2

$T2 = 25°C = 298K$ $T1 = 5°C = 278K$

$\Delta T = T2 - T1 = 298 - 278 = 20K$

Thermal conductivity = 0.8Nm^{-1}K^{-1}

To Find: Heat = Q = ?

Solution: $\frac{Q}{t} = \frac{KA(\Delta T)}{L} \Rightarrow Q = \frac{tKA(\Delta T)}{L} = \frac{3600\times0.8\times5\times20}{0.008}$

Q = 3.6x10^{7}J ANS